BMP-17

BMP: STORMWATER CONVEYANCE CHANNEL

Definition

A permanent, designed waterway, shaped, sized, and lined with appropriate vegetation or structural material used to safely convey stormwater runoff within or away from a developing area.

Purpose

To provide for the conveyance of concentrated surface runoff water to a receiving channel or system without damage from erosion.

Conditions Where Practice Applies

Generally applicable to man-made channels, including roadside ditches and intermittent natural channels, that are constructed or are modified to accommodate flows generated by land development. The implementation of this control should come only after a channel adequacy analysis for capacity and velocity has been performed. The measure should be installed and stabilized prior to the introduction of post-development flows. This practice is not generally applicable to continuous flowing natural streams. Major streams need full design considerations and calculations. Provisions for protecting the banks of such streams are described in VEGETATIVE STREAMBANK STABILIZATION, BMP-22 and STRUCTURAL STREAMBANK STABILIZATION, BMP-23.

Planning Considerations

The design of a channel cross-section and lining is based primarily upon the volume and velocity of flow expected in the channel. If conditions are appropriate, grass or riprap channels are preferred over concrete. While concrete channels are efficient and easy to maintain, they remove runoff so quickly that channel erosion and flooding often result downstream. Grass or riprap channels reduce this problem by more closely duplicating a natural system.

Besides the primary design considerations of capacity and velocity, a number of other important factors should be taken into account when selecting a cross-section and lining. These factors include land availability, compatibility with land use and

surrounding environment, safety, maintenance requirements, outlet conditions, and soil erodibility factor. If the riprap design is chosen, filter fabric must be used to act as a separator and stabilizer between the stone and the earth.

Cross-section design-

Vee-shaped ditches are generally used where the quantity of water to be handled is relatively small, such as roadside ditches. A grass or sod lining will suffice where velocities in the ditch are low. For steeper slopes where high velocities are encountered, a riprap, concrete or bituminous concrete lining may be appropriate.

Parabolic channels are often used where the quantity of water to be handled is larger and where space is available for a wide, shallow channel with low velocity flow. Riprap should be used where higher velocities are expected and where some dissipation of energy (velocity) is desired. Combinations of grass and riprap are also useful where there is a continuous low flow in the channel.

Trapezoidal channels are often used where the quantity of water to be carried is large and conditions require that it be carried at a relatively high velocity. Trapezoidal ditches are generally lined with concrete or riprap.

Outlet design-

Outlet conditions for all channels must be considered. This is particularly important for the transition from a man-made lining, such as concrete and riprap, to a vegetated or nonvegetated lining. Appropriate measures must be taken to dissipate the energy of the flow to prevent scour of the receiving channel. (See OUTLET PROTECTION, BMP-18).

Capacity-

All channels shall be designed in accordance with accepted engineering practices. If channel modifications are necessary, the capacity of the channel must be sufficient to convey the 10-year frequency design storm (24-hour duration) without overtopping the banks. If predevelopment flooding problems exist, the consequences of flooding are severe, or drainage systems which convey larger storms converge with the channel in question, consideration should be given to increasing the capacity beyond the 10-year frequency storm capacity.

Velocity-

Channels should be designed so that the velocity of flow expected from a 2-year frequency storm shall not exceed the permissible velocity for the type of lining used.

While concrete-lined channels can usually be smaller than grass-lined channels, the increased velocity will produce more erosion and flooding downstream.

Grass-lined channels provide good protection against erosion, while they provide an aesthetic setting for conveyance of runoff. However, the velocities that grass linings can handle are much lower than those which can be withstood by riprap or concrete-lined channels. For grass linings, the type of vegetation chosen shall be appropriate for the site conditions: i.e., drainage tolerance, shade tolerance, maintenance requirements, etc. (See PERMANENT SEEDING, BMP-32 and SODDING, BMP-33). Where there will be a base flow in grass-lined channels, a stone center, a subsurface drain, or other suitable means to handle the base flow shall be provided. Refer to RIPRAP, BMP-19 to choose the correct stone size and for filter fabric specifications. Permissible velocities for grass-lined channels are shown in Table 17-1.

Riprap-lined channels can be designed to withstand most flow velocities by choosing a stable stone size. The procedures for selecting a stable stone size for channels and installation is contained in BMP-19, RIPRAP. All riprap must be installed with a filter fabric or gravel (granular) underlining. Transition from a riprap lining to grass and earth linings must be carefully designed to meet the allowable velocities of each type of lining.

Concrete-lined channels are not usually limited in the velocity they can carry; however, it should be kept in mind that the flow velocity at the outlet of the paved section must not exceed the permissible velocity of the receiving channel. See OUTLET PROTECTION, BMP-18.

Depth-

The design water surface elevation of a channel receiving water from diversions or other tributary channels shall be equal to or less than the design water surface elevation of the diversion or other tributary channel at the point of intersection.

The top width of parabolic and vee-shaped, grass-lined channels shall not exceed 9 meters (30 feet), and the bottom width of trapezoidal, grass-lined channels shall not exceed 5 meters (15 feet) unless multiple or divided waterways, riprap center, or other means are provided to control meandering of low flows.

TABLE 17-1: PERMISSIBLE VELOCITIES FOR GRASS LINED CHANNELS

CHANNEL SLOPE	LINING	PERMISSIBLE VELOCITY*
0 - 5%	Bermudagrass	2 meters/sec (6 ft./sec)
	Reed canarygrass Tall fescue Kentucky bluegrass	1.5 meters/sec (5 ft./sec)
	Grass-legume mixture	1.2 meters/sec (4 ft./sec)
	Red fescue Redtop Sericea lespedeza Annual lespedeza Small grains (temporary)	0.75 meters/sec (2.5 ft./sec)
5 - 10 %	Bermudagrass	1.5 meters/sec (5 ft./sec)
	Reed canarygrass Tall fescue Kentucky bluegrass	1.2 meters/sec (4 ft./sec)
	Grass-legume misture	1 meter/sec (3 ft./sec)
Greater than 10%	Bermudagrass	1.2 meters/sec (4 ft./sec)
	Reed canarygrass Tall fescue Kentucky bluegrass	1 meter/sec (3 ft./sec)

* for highly erodible soils, permissible velocities should be decreased by 25%. An erodibility factor (K) greater than 0.35 would indicate a highly erodible soil.

Outlet-

The outlets of all channels shall be protected from erosion (see OUTLET PROTECTION, BMP-18).

Construction Specifications

General-

1. All trees, brush, stumps, roots, obstructions and other unsuitable material shall be removed and disposed of properly.

2. The channel shall be excavated or shaped to the proper grade and cross-section.

3. Any fills shall be well compacted to prevent unequal settlement.

4. Any excess soil shall be removed and disposed of properly.

Grass-lined Channels-

The method used to establish grass in the ditch or channel will depend upon the severity of the conditions encountered. The methods available for grass establishment are set forth in PERMANENT SEEDINGS, BMP-32 and SODDING, BMP-33.

Riprap-lined Channels-

Riprap shall be installed in accordance with RIPRAP, BMP-19.

Concrete-lined Channels-

Concrete-lined channels must be constructed in accordance with all acceptable engineering specifications. The following items highlight those specifications:

1. The subgrade should be moist at the time the concrete is poured.

2. Traverse joints for crack control should be provided at approximately 6 meter (20-foot) intervals and when more than 45 minutes elapses between consecutive concrete placements. All sections should be at least 2 meters (6 feet) long. Crack control joints may be formed by using a 3 millimeter (1/8-inch) thick removable template, by scoring or sawing to a depth of at least 20 millimeters (3/4 inch) or by an approved "leave-in" type insert.

3. Expansion joints shall be installed every 30 meters (100 feet).

Maintenance

Grass-lined Channels-

During the initial establishment, grass-lined channels should be repaired immediately and grass re-established if necessary. After grass has become established, the channel should be checked periodically to determine if the grass is withstanding flow velocities without damage. If the channel is to be mowed, it should be done in a manner that will not damage the grass.

Riprap-lined Channels-

Riprap-lined channels should be checked periodically to ensure that scour is not occurring beneath fabric underlining of the riprap layer. The channel should also be checked to determine that the stones are not dislodged by large flows.

Concrete-lined Channels-

Concrete-lined channels should be checked periodically to ensure that there is no undermining of the channel. Particular attention should be paid to the outlet of the channel. If scour is occurring at the outlet, appropriate outlet protection shall be installed. See OUTLET PROTECTION, BMP-18.

Sediment Deposition-

If the channel is below a high sediment-producing area, sediment should be trapped before it enters the channel. Field experience has demonstrated that many newly constructed conveyance channels become damaged and require costly repairs as a result of improper upslope controls. If sediment is deposited in a grass-lined channel, it should be removed promptly to prevent damage to the grass. Sediment deposited in riprap and concrete-lined channels should be removed when it reduces the capacity of the channel.